A New Paradigm for Quarantine and Public Health Activities at Land Borders: Opportunities and Challenges

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SYNOPSIS

The Institute of Medicine (IOM) report *Quarantine Stations at Ports of Entry: Protecting the Public's Health* focused almost exclusively on U.S. airports and seaports, which served 106 million entries in 2005. IOM concluded that the primary function of these quarantine stations (QSs) should shift from providing inspection to providing strategic national public health leadership.

The large expanse of our national borders, large number of crossings, sparse federal resources, and decreased regulation regarding conveyances crossing these borders make land borders more permeable to a variety of threats. To address the health challenges related to land borders, the QSs serving such borders must assume unique roles and partnerships to achieve the strategic leadership and public health research roles envisioned by the IOM. In this article, we examine how the IOM recommendations apply to the QSs that serve the land borders through which more than 319 million travelers, immigrants, and refugees entered the U.S. in 2005.

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During the first half of the 20th century, the U.S. Public Health Service (PHS) maintained more than 110 quarantine stations (QSs) at international ports of entry throughout the United States, including all major land border ports. The mission of these stations was to prevent the introduction of seven "quarantinable" infectious diseases (cholera, diphtheria, infectious tuberculosis [TB], plague, smallpox, yellow fever, and viral hemorrhagic fever) into the U.S. Their mission was authorized by Title 42 U.S. Code Section 264 (Section 361 of the PHS Act), which gives the U.S. Department of Health and Human Services (DHHS) Secretary responsibility for preventing the introduction, transmission, and spread of communicable diseases from foreign countries into the U.S. Statute regulations found at 42 CFR Parts 70 and 71 delegate authority to the Centers for Disease Control and Prevention (CDC) to detain, medically examine, isolate, quarantine, or conditionally release individuals entering the U.S. who are reasonably believed to be carrying a communicable disease.

In the mid-1960s, as the perceived threat of infectious diseases diminished, the number of QSs fell to seven QSs operated by CDC. These seven stations served 474 international ports of entry. As concern heightened regarding the emergence and importation of infectious diseases such as severe acute respiratory syndrome and pandemic influenza, DHHS renewed its interest in and awareness of CDC's QSs as resources in efforts to prevent and control disease at international ports of entry. The number of QSs increased for the first time in several decades. An eighth station, in Atlanta, Georgia, opened in preparation for the 1996 Olympic Games. Following terrorism- and bioterrorism-related events in 2001, the number of QSs increased to 20 by mid-2007. The QSs in El Paso, Texas, and San Diego, California, began operations in 2005, becoming the first U.S. QSs in more than 40 years that primarily served land borders. In conjunction with the QS station in Detroit, Michigan, which opened in 2006, QSs now have a presence at three major land border crossings that receive a significant proportion of international entries. Airport-based stations in Seattle, Washington; Minneapolis, Minnesota; Boston, Massachusetts; and New York, New York oversee other important land border crossings. In this article, we identify the challenges faced by QSs at land borders and discuss how these stations are meeting these challenges and defining the roles of land border QSs in the 21st century.

THE INSTITUTE OF MEDICINE REPORT

In 2005, a report by a committee of the Institute of Medicine (IOM), *Quarantine Stations at Ports of Entry: Protecting the Public's Health,*[1] drew attention to the important role QSs play in safeguarding the nation's health at its ports of entry and, by extension, its borders. However, as land border QSs had only just begun operations and due to time constraints, the IOM expert committee focused almost exclusively on airports and seaports, rather than land ports and borders. The report divides QS functions into traditional or "legacy" roles and newer, more strategic roles. Legacy roles include regulatory functions, disease detection, and response duties. The newer roles recommended by the IOM included the assumption of leadership roles in strategic public health partnerships with other federal agencies, the World Health Organization (WHO), state and local health departments, cross-border counterparts, and industry to prevent the international spread of infectious diseases. IOM recommended expanding partnerships among these and other partners (e.g., community-based organizations) to facilitate emergency preparedness planning, public health research, and prevention efforts among international travelers and migrants.

VOLUME OF TRAVELERS CROSSING LAND BORDERS

One of the most significant differences between land-based QSs and airport-based stations is the large volume of land border crossings relative to entries at airports and seaports. According to the U.S. Department of Transportation, legal entries into the U.S. numbered more than 319 million at 163 land border ports of entry in 2005, representing 74% of all international entries.[2,3] The combined numbers of airport and seaport entries in 2005 were 80 million and 26 million, respectively. Almost 95 million (30%) international land border crossings occur at the two San Diego and four El Paso ports of entry (Table, Figure). San Diego's San Ysidro port of entry is the world's most frequently crossed international port of entry, with more than 41 million northbound crossings each year, constituting 10% of all land, sea, and air U.S. entries. Entries through airports and seaports from Mexico into the southern border region totaled less than 4.8 million in 2005.

A sizable portion of land border crossings is attributable to people who cross daily or regularly to shop, visit family, or do work or business in U.S. sister-city communities. Others are permanent immigrants, travelers, legal migrant workers, and students crossing land

Table. Fifteen most highly utilized U.S. land border ports of entry, 2005

Port of entry	*City*	*State*	*Number of legal entries*
San Ysidro	San Diego	CA	41,417,164
El Paso[a]	El Paso	TX	39,148,476
Calexico[b]	Calexico	CA	23,178,351
Laredo	Laredo	TX	20,655,651
Brownsville	Brownsville	TX	17,723,154
Hidalgo	McAllen	TX	16,624,157
Nogales	Nogales	AZ	16,142,817
Buffalo-Niagara Falls	Buffalo	NY	16,140,417
Otay Mesa	San Diego	CA	14,143,415
Detroit	Detroit	MI	13,342,312
Eagle Pass	Eagle Pass	TX	9,364,758
San Luis	San Luis	AZ	8,965,574
Blaine	Blaine	WA	5,562,279
Douglas	Douglas	AZ	5,439,973
Port Huron	Port Huron	MI	5,044,980

[a]Includes Bridge of Americas, Paseo del Norte, Ysleta, and Fabens ports of entry.

[b]Includes Calexico and Calexico East ports of entry.

borders to reside in U.S. territory permanently or for an extended period. Unlike travelers at airports and seaports, the vast majority of entrants use private vehicles. The remainder cross as pedestrians (especially to and from metropolitan sister cities on the U.S.-Mexico border), arrive by bus, or, least commonly, by train. According to the U.S. Department of Transportation, more than 3.7 million bus passengers enter the U.S. from Mexico each year. Incoming truck traffic from Mexico totaled 4.6 million vehicles in 2005, with 1.5 million trucks crossing at Laredo, Texas; 741,000 at El Paso; and 730,000 at Otay Mesa/San Diego.

At the U.S.-Canada border, approximately 74 million people entered the U.S. in 2005. The three busiest crossing points were Buffalo-Niagara Falls, New York (16.1 million), Detroit (13.3 million), and Blaine, Washington (5.6 million). Certain characteristics, such as the large volume of cross-border commuters and the substantial flow of individual travelers and freight, are similar at both northern and southern U.S. borders. However, public health issues at the Canadian border differ from those at the U.S. southern border because of relatively prosperous socioeconomic conditions in Canada and the substantial public health infrastructure there.

The unauthorized border-crossing population is understandably less well characterized. In 2006, U.S. Customs and Border Protection (CBP) estimated 11.6 million undocumented aliens were living in the United States.[4] Of these, an estimated 4.2 million had entered in 2000 or later and an estimated 6.6 million were from Mexico. About 7.2 million were employed in March 2005, accounting for roughly 5% of the civilian labor force. Most reside in border states in the Southwest. Others live throughout the United States, working as migrant laborers in urban areas such as New York, Chicago, and Atlanta, and in rural areas of Washington State, North Carolina, Kansas, and elsewhere. In 2005, CBP reported the apprehension of almost 1.2 million undocumented aliens crossing the U.S.-Mexico border.[5] Most (86%) detainees were Mexican nationals, an additional 10% were from Central America, and nearly 3% were from Brazil. Countries in the eastern hemisphere, including China, accounted for less than 1%.

CURRENT STATUS OF INFECTIOUS DISEASE SURVEILLANCE AND PUBLIC HEALTH AT LAND BORDERS

Detection and surveillance of illness among populations crossing borders

Illness screening approaches used at land border QSs are similar to those used at airports and seaports and include verification of prior medical screening of immigrants. CBP, with the aid of the transportation industry, conducts passive primary screening of other travelers for signs and symptoms of infectious diseases of public health importance. QSs assist with or conduct secondary screening at ports of entry.

First-time immigrants (e.g., legal or permanent residents, long-term visitors, and fiancées of U.S. citizens and residents) generally receive medical screening through U.S. State Department-sanctioned physician groups known as panel physicians. Panel physicians in Cuidad Juarez and Tijuana, Mexico, and various Canadian cities examine immigrants from Mexico and Canada. El Paso–Ciudad Juarez serves as the main processing hub for the medical documents for immigrant residents entering the U.S. from Mexico and for a small proportion of those entering from Central and South America. According to the U.S. Consulate in Ciudad Juarez, more than 80,000 immigrant visa applications are reviewed every year, of which more than 50,000 are approved for immediate admission.

At airports and seaports, government regulations require conveyance crews to notify federal officials about ill passengers before arrival and to screen each traveler individually. In contrast, illness reporting requirements and protocols are poorly defined for conveyances crossing land borders into the United States. Illnesses are less likely to come to the attention of CBP

Figure. Map of major U.S. land border ports of entry

agents or public health authorities at land border QSs for these reasons:

- Established illness notification procedures for land conveyances are lacking;
- The greater volume of legal crossings is not matched by proportionately larger numbers of staff, giving CBP less time to screen each traveler;
- Passengers remain in their personal vehicles during crossing (unless directed to secondary inspection); and
- There is a higher volume of unauthorized immigrant entries.

Data collected during 2006 by CDC's Quarantine Activity Reporting System also suggest that screening is a greater challenge at land border crossings. Reported illnesses at land border crossings constituted less than 1% of the total reports, while land border crossings comprised 75% of all port entries.

Lack of routine identification of recent international arrivals by state and local public health partners further hampers detection of diseases of public health importance acquired outside the U.S. Once patients leave Federal Inspection Service areas, state and local disease reporting authorities and practices take precedence. Investigation and reporting practices may not include routine collection of information about recent international travel. Even when such information is collected, federal notification may not occur for many months, greatly hampering investigation and control of travel-related risks and contacts. Surveillance of illnesses in clinics that specialize in illnesses in travelers can serve as sentinel systems, as can surveillance in health-care settings that primarily serve international clientele.[6] Ambulance dispatch data hold promise as a surveillance resource to enhance detection and collection of information on more serious illnesses among immigrants and travelers at land borders. Analysis of such data for El Paso focused on the 1,356 U.S.

ambulance transfers that occurred in 2004. Of these, 152 (11%) were reported to have syndromes of possible public health concern, including fever, skin lesions, and diarrheal illnesses with fever.

Health problems among undocumented aliens are even more difficult to keep under surveillance. Deaths and serious injuries are all too commonplace.[7–10] Mexican or Central American residents accounted for 5% of all pediatric deaths in one county in Arizona.[8] Causes included motor vehicle crashes (32%), environmental exposure (17%), premature birth (11%), other trauma (11%), and other medical conditions (28%). Perhaps the best information on nonfatal illness among undocumented aliens may come from medical records of detainees of the U.S. Immigration and Customs Enforcement, CBP.[11]

Surveillance of illnesses in border communities documents that a number of infectious diseases are more common at the U.S.-Mexico border than elsewhere in the United States.[12] Infectious diseases considered especially problematic include:

- TB[11,13–17]
- Vaccine-preventable diseases such as varicella and hepatitis A[12,18]
- Foodborne and waterborne illnesses[12,19,20]
- Sexually transmitted diseases[21,22]
- Zoonoses such as brucellosis and *Mycobacterium bovis*[23]
- Vector-borne diseases such as dengue[24]

Binational surveillance initiatives to strengthen reporting, partnership, and capacity

Awareness of the relationship between diseases on both sides of the U.S.-Mexico border led to the development and implementation of a number of binational surveillance initiatives. Among the first was the creation of the U.S.-Mexico border infectious disease enhanced surveillance system in 1997.[25] The U.S. Council of State and Territorial Epidemiologists and the U.S.-Mexico Border Health Association both endorsed this concept. A consensus and collaborative process with the Mexico Secretariat of Health, states on both sides of the border, and local jurisdictions developed novel binational surveillance systems for viral and rickettsial diseases of public health importance to both countries. The goals of the system extend beyond surveillance to include the following:

- Establishing a network of epidemiologists and laboratories at the U.S.-Mexico border
- Improving epidemiology and laboratory infrastructure in the region
- Exchanging uniform epidemiologic data
- Using binational epidemiologic data to improve disease prevention and control in the region

The project was successful in accomplishing these goals, despite predictable barriers to binational collaboration, including language and culture, and different health and regulatory systems.

In 2003, DHHS awarded early-warning infectious disease surveillance funding through the CDC Coordinating Office of Terrorism Preparedness and Emergency Response to state health departments in U.S. northern and southern border states to enhance training for bioterrorism preparedness and to improve the cross-border infrastructure for epidemiology, laboratory, and communications. DHHS also designated funds to the Mexico Secretariat of Health and Mexico's northern border states for the same purpose. Mexico received these funds in late 2006. The San Diego and El Paso QSs work actively with both U.S. and Mexico border states to help foster and develop better binational disease preparedness and surveillance.

Among the disease problems of importance to land borders are high rates of TB in foreign-born individuals. The proportion of U.S. TB cases in foreign-born individuals increased from 30% in 1993 to 42% in 1998 and 57% in 2006.[26,27] Of the total foreign-born patients, approximately 25% were born in Mexico. More than 75% were reported by the U.S. states bordering Mexico, Arizona, California, New Mexico, and Texas.[28] In 2001, TB case rates were five times higher for Mexican-born than for U.S.-born people in those four border states.

The high rates of TB in foreign-born individuals prompted CDC to collaborate with binational state and local partners to implement several successful binational TB initiatives, including:

- Juntos in El Paso/Ciudad Juarez
- Los Dos Laredos in Laredo/Nuevo Laredo
- Grupo sin Fronteras in Brownsville/Matamoros
- Cure TB in San Diego/Tijuana
- The U.S.-Mexico Binational TB Referral and Case Management Project

Among other accomplishments, these projects established a common case definition for binational TB cases and improved binational TB case management and control among mobile transborder populations. The cost in federal and state resources of these projects has been relatively modest. A recently published cost analysis concluded that funding directly observed therapy initiatives in Mexico and other foreign countries with a significant TB burden is a cost-effective way

to prevent future TB cases in the U.S.[29] An additional example of land border QS involvement in TB control is the recent experience of the San Diego and El Paso QSs in working with local health departments and CBP at ports of entry to identify known noncompliant binational individuals with infectious TB for counseling and possible local isolation orders.

Since 2000, CDC has organized and supported an annual border infectious disease surveillance meeting that includes representatives of the two federal governments, border states of both countries, the U.S.-Mexico Border Health Commission, academic institutions, and other interested stakeholders.[30] Concurrently, the U.S.-Mexico Binational Commission Core Health Working Group on Epidemiology and Surveillance drafted a document providing clear guidelines for the uniform exchange of epidemiologic information between the U.S. and Mexico, in accordance with the new WHO International Health Regulations.[31] Border states expect to develop and implement operational protocols to pilot these guidelines in 2009. A U.S.-Mexico ad hoc technical coordinating workgroup for epidemiology and laboratory surveillance involving CDC and including land border QSs is organizing to provide a strategic framework and follow-up for binational epidemiologic collaborations.

In 2005, the United States, Canada, and Mexico agreed to strengthen collaboration among the three North American countries. The Security and Prosperity Partnership contains several public health mandates, including enhancing public health cross-border coordination in infectious disease surveillance, prevention, and control.[32] Recently, under the leadership of the Department of Homeland Security and DHHS, including CDC, several workgroups formed to address specific issues regarding pandemic influenza preparedness for North America. During a 2006 Security and Prosperity Partnership meeting in Ottawa, Canadian participants in the epidemiology and laboratory workgroup expressed interest in developing a North American version of the draft U.S.-Mexico epidemiology guidelines document.

RECOMMENDATIONS ON UNIQUE ROLES OF LAND-BASED QSs

As mentioned, the IOM report did not address land border stations or activities. The mix of legacy duties and new roles will differ in land border QSs compared with airport- and seaport-based stations. The volume of cross-border traffic (at legal ports of entry and illegally throughout the international frontier), the unique relationships of certain sister cities at the U.S.-Mexico and U.S.-Canada borders, and the important differences in public health systems in the three countries suggest that the roles and approaches of the land border stations may vary from those of airport-based QSs in other areas of the country. These factors also offer opportunities for the land border stations to fulfill the expanded IOM mandate for relevant research, expanded surveillance, and community public health leadership in innovative ways.

Illness notification and response

Public health officials based at land border QSs are less likely than those at airport-based stations to receive advance reports of ill passengers and reports at the time of entry. Consequently, increased efforts must go into working with partners to alert federal officials about situations of public health interest. These efforts will entail considerable training and relationship building among the land QSs, CBP, and federal, state, and local partners. As previously noted, the illness notification requirements for conveyances common to land ports, which includes long-distance passenger buses, commercial trucks, private vehicles, and trains, need strengthening. Because of high volumes and the intrinsic difficulties in detecting illness in conveyances lacking crew at land border ports, land border QSs should place emphasis on identification of severe illness. For these reasons, as well as relatively limited staffing, even with concerted education and outreach efforts, illness reporting and response rates at land border ports may be less than that seen in other QSs.

Building partnerships

Partnering with local and state health departments and international counterparts in migrant health epidemiology should be an important element for land border QSs. The prime mission of CDC's QSs is to prevent the introduction of infectious diseases into the U.S. and to control the spread of communicable diseases across the border. Yet, local and state health departments have limited resources for immigrant health and incomplete authority to carry out disease-control activities at the border. Working together, CDC border federal agencies, local public health partners, and other stakeholders such as academic institutions can establish special disease surveillance systems, carry out applied research, and use surveillance and research data to design and implement innovative disease interventions for mobile border populations. A notable example of such a project is a random survey of recent immigrant households conducted by QS staff in collaboration with the local health department in San Diego County census tracts regarding knowledge,

attitudes, and practices related to infectious disease and other public health issues.[33]

The foundation provided by binational public health projects, as well as the new WHO International Health Regulations, offer a model for including Mexico and Canada in these new partnerships. Just as international commercial transportation carriers notify public health authorities at ports of entry about ill passengers before their arrival, Mexican or Canadian public health authorities can alert their counterparts in the United States about disease outbreaks and cases of binational public health significance. These efforts will also enhance binational bioterrorism response readiness for border communities along U.S. southern and northern borders. Again, land border QSs can play a critical role in communication and in fostering, sustaining, and enhancing such partnerships.

Facilitating binational projects

CDC has been instrumental in the successful implementation of binational surveillance and treatment initiatives (e.g., TB). The continued success and expansion of such projects depend on CDC's continued involvement. Land border-based QSs are ideally located to continue supporting and even expanding these initiatives to include human immunodeficiency virus and sexually transmitted diseases. For Mexico, efforts to build binational surveillance capacity include developing public health infrastructure and sharing resources. Another such effort has been reference microbiologic testing of laboratory specimens in U.S. public health laboratories, including those at CDC. For Canada, the need is more likely to be in the areas of communication, coordinated surveillance and case finding, and laboratory partnerships. Land border QSs can also partner with international organizations and Canadian and Mexican agencies to develop public health training activities that can improve technical capacity and achieve mutual understanding of each other's public health systems.

Movement of equipment and reagents to Mexico has been an important aspect of infrastructure enhancement. Land border QSs can play a major role in working with CBP, the U.S. Food and Drug Administration, and counterpart agencies to facilitate the timely cross-border passage of key public health equipment, supplies, and specimens for public health and emergency response.

Binational cases and outbreaks, and collaboration with Immigration and Customs Enforcement

Binational cases and outbreaks are defined as notifiable diseases or outbreaks with public health implications for the sister country. Recent examples include:

- TB cases among people known or expected to cross the border during the course of their treatment
- Measles, rubella, or dengue diagnosed in people from one country, but living in another
- Foodborne outbreaks of enteric diseases detected in one country and associated with a product from the other country

Such epidemiologic events are common in North America and normally do not meet published criteria by the WHO for public health emergencies of international concern.[31] Border-region QSs can and should play a critical role in reporting such cases to federal-level counterparts in Mexico or Canada and in investigation and follow-up when appropriate. The previously mentioned draft U.S.-Mexico guidelines document summarizes legal authorities for binational epidemiologic data exchange. The document also has important sections describing standards for notification of binational cases of infectious disease of public health importance, and notification and joint investigation of infectious disease outbreaks.

A special type of binational case frequently encountered is the illegal immigrant held in Immigration and Customs Enforcement detention facilities who has a notifiable condition detected by the Department of Homeland Security's Division of Immigration Health Services staff in the facility. Historically, many such patients have been repatriated to Mexico and Central America without regard for the binational public health implications of deportation and reentry, creating the possibility of uncontrolled disease transmission. Recent efforts by land-based QSs, the Division of Immigration Health Services, and border state health departments have focused on binational management of TB cases diagnosed in Immigration and Customs Enforcement facilities. One such study showed that, in 2005, the TB rate among this population was 122 per 100,000, compared with about 12 per 100,000 in Texas and about 45 per 100,000 on the Mexico side of the border with the United States.[11,34] Again, land QSs can play an increasingly important role in helping to ensure that patients with TB or other conditions are managed according to best practices of public health disease control in this binational context.

Binational cases and outbreaks can come to the

attention of health departments anywhere in the U.S. because of the widespread distribution of Latin American migrants in the U.S. Thus, land border QSs, in conjunction with local and state health departments in their regions, will undoubtedly have the opportunity and the responsibility to carry out and support binational notifications and investigations. Involvement in public health assessments and interventions targeting Mexican and other migrant populations in their communities will also be important for QSs throughout the country.[33]

Research

The difficulty of obtaining population-based data among travelers at land borders supports IOM's recommendation that clear and strategic priority be given to conducting research at QSs to better define and focus attention on issues of public health significance. Such issues at land borders almost certainly include:

- Travelers' health in Mexico and Central America
- Illness importation from other countries through land borders
- Migration patterns of land border immigrants

Land border QSs have numerous opportunities for applied public health research in these areas of intense migration and population movement. Health research infrastructure is relatively modest at the U.S.-Mexico border, and data are often inadequate to characterize border community health status. The need for coordinated research is especially evident at federal ports of entry and in the binational arena, but the difficulty of involving multiple federal and other partners from both sides of the border often limits opportunities. Border QSs are ideally situated to interface with regional binational public health partners by fostering and facilitating applied research and sharing key public health data gathered in the border region.

Preparing for emergency prevention and control response

All QSs will partner with other federal agencies and local and state health departments in preparedness activities related to quarantine and isolation at ports of entry. That partnership extends to situations involving risk of international and interstate spread of communicable diseases via transportation carriers. QS personnel are part of the public health infrastructure for overall preparedness, providing disease detection, investigation and response, and communication and coordination. Land-based stations in border sister-city regions have an especially challenging role to play. The potential volume of travelers that must be screened greatly exceeds those seen at airports and seaports. The border location of land QSs places them in a unique situation to represent CDC with binational counterparts in Mexico and Canada. These stations are also likely to play an important role in cross-border communication and coordination. Such federal representation is particularly critical in Mexico's centralized public health system. Land-based stations strengthen preparedness and response plans via ongoing communication with CDC and local and state partners, and participation in and hosting of tabletop and real-time exercises. The El Paso, San Diego, and Detroit QSs are developing land border port preparedness plans. These plans outline a unified approach for response and cross-border coordination.

CONCLUSION

The IOM report did not address land borders, but its recommendation that QSs can take a public health leadership role is well suited to land border QSs. Land border QSs have unique characteristics compared with airport- and seaport-based stations. A different balance and mix of activities are necessary at land border QSs. These activities should include cross-border surveillance, binational TB control, research, and preparedness, with emphasis on the following to support the activities:

- Developing protocols for illness reporting at land borders addressing people entering by bus, train, or passenger vehicle
- A varied and strengthened repertoire of surveillance and control activities to detect, prevent, and control established, emerging and reemerging, and potential bioterrorism-related infectious diseases
- Working and regular communication with diverse partners to facilitate binational communication, transborder travel, and movement of public health supplies necessary to assure ongoing collaboration

Finally, given the vast territory and number of travelers at both the northern and southern borders, additional land-based QSs or substations should be a continued priority.

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